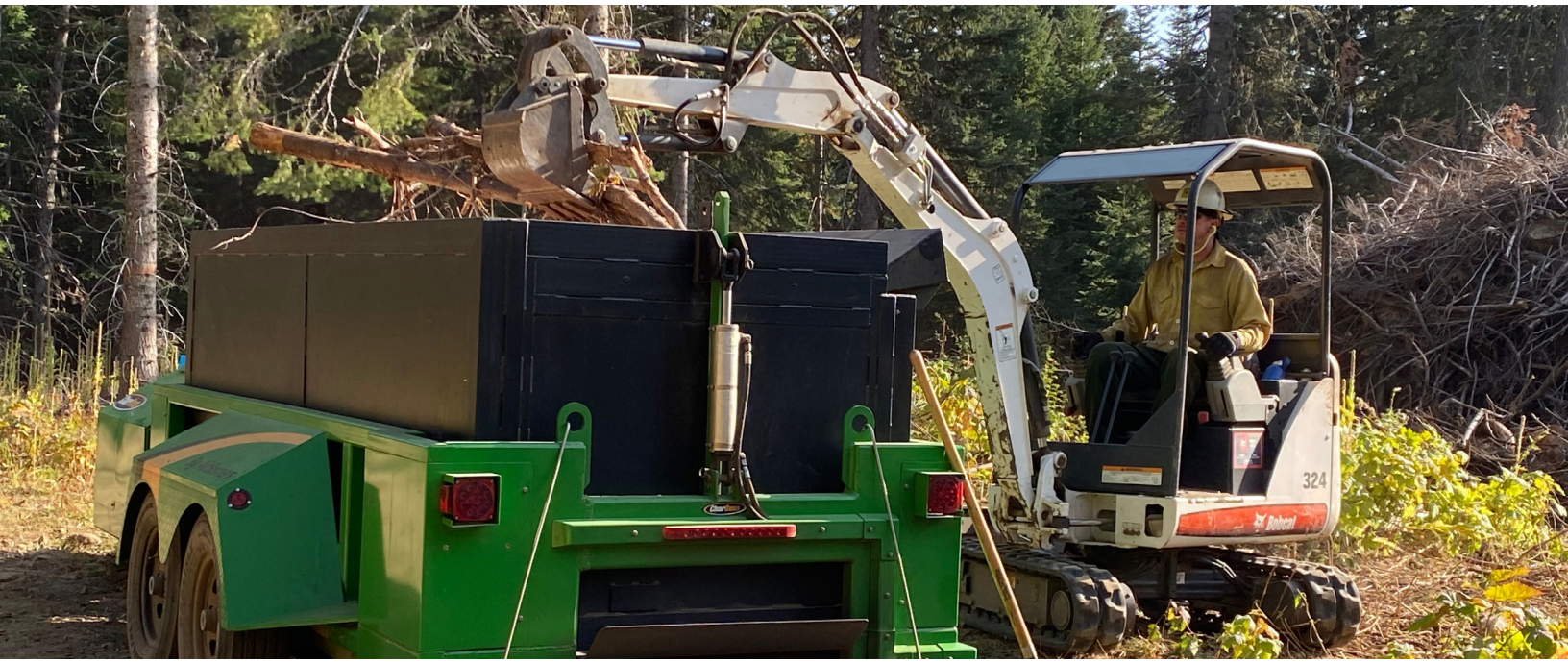
Forest Service
U.S. DEPARTMENT OF AGRICULTURE

FS–1161(l) | July 2021



Biochar Is Building a Sustainable Future From the Soil Up

An air curtain burner producing biochar from forest slash during a demonstration project. Courtesy photo by U.S. Biochar Initiative.

Biochar is a “carbon game-changer.” That’s a message Tom Miles, director of the U.S. Biochar Initiative (USBI), never gets tired of delivering. Biochar is fine-grained charcoal found naturally in soils around the world as a result of vegetation fires or from human applications. Biochar can also be manufactured in specially designed, low-oxygen furnaces that heat biomass such as wood, manure, and crop residues.

Biochar can benefit forests, rangelands, and agricultural lands by improving soil health and productivity. It can improve the soil’s capacity to hold water, providing more water for growing plants and reducing runoff and erosion from rain or snowmelt. Biochar (and reduced runoff) also improves soil nutrient content, providing more nutrients for plant growth.

Biochar production can also support a new rural industry that includes biofuels and other biobased products. That potential new industry offers good jobs and new markets for sustainably harvested biomass crops, crop residue, and, importantly, offers the potential to monetize wood residues from forest restoration efforts and hazardous fuel reduction.

USBI and the Forest Service: working together to spread the word about biochar

Since 2017, support from and collaboration with the U.S. Department of Agriculture (USDA), Forest Service has helped in education, technical assistance, market development, and product development for biochar. USBI is a not-for-profit organization. “Support from the Forest Service has been key to the growth of our sector. I see us transitioning from a sector full of committed enthusiasts to a mature, viable industry,” Miles says. The U.S. Biochar Initiative’s collaboration with the Forest Service has produced a series of biochar webinars that bring the sector together and build new relationships.

Biochar is a climate-smart solution

Using wood for long-lived products, such as buildings, is a recognized way to sequester carbon. Similarly, biochar is another method to sequester carbon because it maximizes the amount of carbon used while minimizing its potential to decompose. Unlike burning fossil fuels, creating biochar in low-oxygen furnaces can produce energy in a carbon-neutral process. Tipping fees, overloading landfills, and open burning (e.g., slash piles) are also avoided when low-value biomass becomes a marketable product. Less waste means less carbon dioxide (CO2) and methane (CH4) emissions from landfills as well.

Depending on the conversion method, biochar retains about 50 to 80 percent of the carbon from the raw biomass. When applied to soil, it sequesters that carbon for centuries, reducing the overall amount of atmospheric CO2 by removing it from the active carbon cycle. Biochar as a soil supplement can also enhance plant growth, which in turn absorbs more CO2 from the atmosphere.

"Biochar with safeguards" was ranked as the strategy with the highest soil carbon sequestration potential in Natural Climate Solutions, a 2017 research article in the "Proceedings of the National Academy of Sciences" journal. Safeguards ensure meeting human needs for food and fiber. Biochar's potential to mitigate climate change is also cited in the Intergovernmental Panel on Climate Change 2018 Special Report.

The many benefits of biochar: from reducing wildfires to carbon offsets

Biochar production provides more than carbon sequestration and renewable energy. Forest management to mitigate wildfire risk creates biomass that is normally burned in slash piles. Using this biomass to produce biochar reduces fuel for wildfires, insect and disease outbreaks, and invasive species. Biochar can be produced in equipment that ranges from small, mobile kilns to industrial-sized units for heating and power generation. Heat and power produced during the process can generate electricity and provide heat for individual homes, businesses, or entire communities.

When biochar is produced, combustible gases, including hydrogen, can be captured to create syngas, a valuable fuel that can be sold or used onsite for energy production. Bio-oil is another prized energy byproduct. Carbon credits can be earned by using biochar.

Biochar recommendations

"We would also like to establish a national 10-year, multisite program of coordinated research with the USDA and land-grant universities. This would help develop new knowledge to predict the effect of biochar additions on soil health, carbon sequestration, and greenhouse gas emissions," Miles says. Biochar advocates and Forest Service partners are also calling for support to develop a new industry producing biochar and its coproducts.

FAST FACTS

- Using wood waste to produce biochar reduces wildfire risk by cleanly disposing of low-value biomass with no markets.
- When managed sustainably, the biochar process is carbon negative.
- Biochar turns biomass waste into a valuable resource.
- Heat and power produced during biochar production can generate electricity.
- Biochar can support a new rural industry.

More Information

Charlie Becker, Forest Products Technologist
USDA Forest Service, Forest Products Laboratory
charles.becker@usda.gov, 608–231–9326

Biochar made from forest slash. Courtesy photo by U.S. Biochar Initiative.